



AEC-NASA TECH BRIEF



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Investigation of Temperature Dependence of Development and Aging

A paper is presented giving an analysis and theoretical discussion of published data on the temperature dependence of maturation rates, plus metabolic and mortality rates in insects.

This paper asks how living poikilothermic systems are affected in their aging and longevity by operating at different constant ambient temperatures. An attempt is made to put the effects of temperature on aging into context with the effects of temperature on essential life processes such as maturation and energy metabolism, and on the failure of those processes, as manifested in gene mutation, developmental anomaly, and mortality during development.

It is shown that the rate of aging per calorie expended increases on either side of a temperature optimum, and that this increase is complementary to the decrease in energetic efficiency of maturation of insects as temperature is displaced from optimum. Failures of vital processes, such as mutations, developmental anomalies, and developmental death also exhibit a temperature minimum. The temperature for optimum function (highest energetic efficiency and lowest failure rate) is found to be always within the temperature range to which that insect species is adapted.

These phenomena are proposed to be a result of the increase in organizational entropy as temperature is displaced from an optimum value. This increase is proposed to be a result of an irreducible heterogeneity of activation energies of enzyme-catalyzed reactions.

The general hypothesis is advanced that aging in biological systems is a consequence not of metabolic activity *per se*, but rather of the production of entropy concomitant with metabolic activity. Thus, aging can no longer be considered as a question of *how much*

metabolic work; it is also a function of *how well* the work is done, in thermodynamic and informational terms.

Notes:

1. The paper, entitled "The Complementarity of Entropy Terms for the Temperature-Dependence of Development and Aging," has been presented by George A. Sacher of Argonne National Laboratory, Argonne, Illinois.
2. This information may be of interest to governmental agencies, research biochemists, and medical foundations working in the field of aging.
3. Reference: Additional details are contained in *Annals of the New York Academy of Sciences*, vol. 13., article 2, p. 680-712 (February 6, 1967)
4. Inquiries concerning this innovation may be directed to:

Office of Industrial Cooperation
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439
Reference: B69-10022

Source: G. A. Sacher
Biological and Medical Research Division
Argonne National Laboratory
(ARG-10145)

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

Mr. George H. Lee, Chief
Chicago Patent Group
U.S. Atomic Energy Commission
Chicago Operations Office
9800 South Cass Avenue
Argonne, Illinois 60439

Category 04



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The purpose of this Tech Brief is to provide a summary of the results of the research and development program conducted by the Atomic Energy Commission and the National Aeronautics and Space Administration in the field of the development of a new type of rocket engine.

1. SUMMARY OF THE PROGRAM

The program was conducted under the leadership of the Director of the Office of Space and Astronautics, Atomic Energy Commission, and the Associate Administrator for Space, National Aeronautics and Space Administration. The program was designed to develop a new type of rocket engine which would be capable of operating at a higher altitude than the existing engines. The program was divided into two main phases: the first phase was devoted to the development of a new type of engine, and the second phase was devoted to the development of a new type of engine which would be capable of operating at a higher altitude than the existing engines. The program was conducted in cooperation with the National Aeronautics and Space Administration, the Atomic Energy Commission, and the National Science Foundation. The program was conducted in the following manner: the first phase was devoted to the development of a new type of engine, and the second phase was devoted to the development of a new type of engine which would be capable of operating at a higher altitude than the existing engines. The program was conducted in cooperation with the National Aeronautics and Space Administration, the Atomic Energy Commission, and the National Science Foundation.

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